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VetRecord Case Reports

Simultaneous use of a lateral caudal and caudal superficial epigastric axial pattern flap for wound closure in a dog

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Keywords:	Reconstruction surgery, Soft tissue surgery, Wound management, Trauma
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Abstract:	A dog presented following a suspected dog bite with a large area of necrotic skin centred over the caudo-dorsal lumbar area extending laterally to the left and right thigh and to the level of the vulva on the right side. This case report describes the successful use of a lateral caudal axial pattern flap used simultaneously with a caudal superficial epigastric axial pattern flap to provide complete closure of the wound. Skin flap survival was 100% with no reported complications.

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<p>TITLE OF CASE <i>Do not include "a case report"</i></p> <p>Simultaneous use of a lateral caudal and caudal superficial epigastric axial pattern flap for wound closure in a dog.</p>
<p>SUMMARY <i>Up to 150 words summarising the case presentation and outcome (this will be freely available online)</i></p> <p>A dog presented following a suspected dog bite with a large area of necrotic skin centred over the caudo-dorsal lumbar area extending laterally to the left and right thigh and to the level of the vulva on the right side. This case report describes the successful use of a lateral caudal axial pattern flap used simultaneously with a caudal superficial epigastric axial pattern flap to provide complete closure of the wound. Skin flap survival was 100% with no reported complications.</p>
<p>BACKGROUND <i>Why you think this case is important – why did you write it up?</i></p> <p>Treating large skin defects in the caudo-dorsal lumbar and perineal regions can be challenging, both in respect of their immediate management and achieving wound closure. This is the first reported case where a caudal superficial epigastric axial pattern skin flap (APF) has been used in conjunction with a lateral caudal APF in a dog to successfully repair a large caudo-dorsal and</p>

1 perineal skin defect. The simultaneous use of two APFs, described in this case, provides a
2 further treatment option for managing large wounds in challenging locations.
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6 **CASE PRESENTATION** *Presenting features, clinical and environmental history*

7 A three-year-old, female neutered, German Shepherd dog was referred with a three-day history
8 of lethargy and reluctance to move. There were no previous health concerns reported. Prior to
9 referral the dog had been treated empirically with antibiotics and non-steroidal anti-inflammatory
10 drugs, but her clinical condition had not improved.
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15 On presentation the dog was reluctant to stand and move. She was tachycardic and pyrexic
16 (41.2°C) with pain elicited on palpation of the lumbosacral spine and pelvis. Matting of the
17 haircoat was noticed at this area.
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23 Under general anaesthesia the dog's hair coat was clipped revealing several large areas of
24 ischaemia and necrosis (Figure 1 and Figure 2) extending from the caudo-dorsal lumbar area
25 laterally to the left and right thigh and to the level of the vulva on the right side. A dog bite was
26 suspected and the owner confirmed that the dog had recently been attacked by another dog in
27 the house, although no wounds or blood had been noted at the time of the incident. Staged
28 sharp, surgical, hydrosurgical (Versajet®, Smith and Nephew) and mechanical (Debrisoft Pad®,
29 Lohmann and Rauscher, and wet to dry dressings) debridement of the wound was performed
30 over the following two days until the necrotic tissue had been removed revealing the full extent of
31 the wound (Figure 3). Thereafter, the wound was managed using polyurethane foam dressings
32 until a healthy granulation bed had formed (Figure 4). A swab was taken from the wound and
33 sent for culture and sensitivity thirteen days after initial presentation. Reconstructive surgery was
34 performed fifteen days after initial presentation.
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50 **INVESTIGATIONS** *If relevant*

51 On initial presentation there was a marked monocytosis ($5.78 \times 10^9/L$; reference range: 0.16 -
52 $1.12 \times 10^9/L$). Thoracic radiographs were unremarkable, while abdominal radiographs showed soft
53 tissue swelling over the affected region and ventral lumbar spondylosis. Bacterial culture was
54 negative.
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DIFFERENTIAL DIAGNOSIS <i>If relevant</i>

TREATMENT *If relevant*

The dog was anaesthetised and aseptically prepared for reconstructive surgery of the wound.

The hair coat was clipped from the caudal thorax and abdomen circumferentially including both hindlimbs and the tail. An indwelling urinary catheter was placed aseptically and connected to a closed collection system. A purse string suture was placed in the anus and removed at the end of surgery. The dog was initially positioned in dorsal recumbency, but was subsequently repositioned intraoperatively into left lateral and then ventral recumbency.

With the dog in dorsal recumbency, a peninsular right caudal superficial epigastric APF was raised caudal to the second nipple using the technique described by Pavletic.¹ The donor site was closed routinely in two layers (Figure 5). A bridging incision was made and the flap rotated without tension by 180 degrees into the wound on the right perineum and thigh. The dog was repositioned into left lateral recumbency and the flap was secured to the bridging incision, vulvar skin and the ventral aspect of the right thigh wound in two layers (Figure 6) after excising the margins of the wound bed. All wounds were closed in two layers using an absorbable suture material using polyglecaprone (3-0 Monocryl; Ethicon) in a simple continuous pattern in the subcutaneous layer and using a combination of both cruciate mattress sutures using monofilament nylon (3-0 Ethilon; Ethicon) and skin staples in the skin.

The dog was repositioned into ventral recumbency and a lateral caudal APF was created.¹ A skin incision was made in dorsal midline along the tail incorporating approximately 40-50% of the length of the tail. The caudal vertebrae were fileted out carefully to avoid damaging the lateral caudal vessels and a high caudectomy performed by disarticulation (Figure 7). The remaining skin around the tail base and the margins of the wound over the left dorsal thigh were undermined, once again after excising the margins of the wound bed. Two ½" Penrose drains were placed prior to wound closure. The lateral caudal axial pattern flap was secured dorsally at the recipient site, with the skin being closed in two layers as before (Figure 8).

Non-adherent dressings (Primapore; Smith and Nephew) were applied to the caudo-dorsal wounds, caudal superficial epigastric donor site and around the Penrose drains. An Elizabethan

collar was placed to minimise self-trauma.

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3 Medetomidine (Domitor, 1mg/ml; Vétoquinol) and ketamine (Anesketin, 100mg/ml; Dechra)
4 constant rate infusions (1-2µg/kg/hr and 2-3µg/kg/hr respectively), buprenorphine (0.02mg/kg, iv,
5 qid, Alvegesic, 10mg/ml; Dechra), paracetamol (10mg/kg, po, bid) and gabapentin (15mg/kg, po,
6 bid, Gabapentin; Sandoz) provided analgesia with sedation for six days post operatively. The
7 wound dressings and those covering the Penrose drains were changed as dictated by the level
8 of adherence, soiling and exudate. Amoxicillin/clavulanic acid (20mg/kg, po, qid, Noroclav;
9 Norbrook) was continued peri-operatively. The urinary catheter was removed four days post
10 operatively. A urine sample, collected by cystocentesis, was sent for culture and sensitivity; a
11 negative culture was obtained. The Penrose drains were removed sequentially: the right after
12 five days and the left after six days once the level of exudate on the dressings covering the
13 drains had subjectively reduced to that expected due to the presence of the drains alone.
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15 The dog was discharged eight days post operatively. The paracetamol, gabapentin and
16 amoxicillin/clavulanic acid were continued orally for seven days.
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31 **OUTCOME AND FOLLOW-UP**

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33 Skin sutures and staples were removed fifteen days post operatively. At this time there was no
34 evidence of wound dehiscence or necrosis of the skin flaps. Three weeks post operatively the
35 axial pattern flap survival was 100% (Figure 9). The patient was subsequently lost to follow-up.
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37 Management of large wounds in the caudo-dorsal and perineal region can be challenging
38 because the skin is relatively less mobile than in other regions of the body making simple
39 appositional wound closure difficult.^{2, 3} The close proximity to the anus and vulva, with the
40 associated risk of urine and faecal soiling of the wounds and dressings, can also be problematic.
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50 **DISCUSSION** *Include a very brief review of similar published cases*

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53 Axial pattern skin flaps incorporate direct cutaneous arteries and veins and are consequently
54 useful in the management of large wounds because they allow for mobilisation of large areas of
55 full thickness skin.^{3, 4} The presence of an independent blood supply also means they are useful
56 in wound beds which may be infected or otherwise compromised.³
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1 Many APFs have been described, but the caudal superficial epigastric axial pattern flap is one of
2 the most adaptable and commonly used.^{3,5} It can be used for closure of wounds to the caudal
3 abdomen, flank, perineum, prepuce and hindlimbs.^{4,6,7} The superficial epigastric vein and artery,
4 a branch of the external pudendal artery, pass through the inguinal canal, providing blood supply
5 to this flap.⁶ The flap commonly incorporates three to four caudal mammary glands that will
6 remain functional and so ovariohysterectomy is recommended.⁶ The caudal superficial epigastric
7 flap has a wide arc of rotation and is most commonly used as a peninsular flap retaining a
8 cutaneous connection at the base of the flap.³ It can also be used as an island flap whereby the
9 cutaneous connection is cut and the flap's only attachment to the donor site is the vascular
10 bundle increasing the flap's arc of rotation. This was not required in this case because the length
11 of the flap created avoided tension on the flap as it was rotated, and the vessels were well
12 protected by fat.
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27 The lateral caudal axial pattern flap incorporates the lateral caudal arteries, which arise from the
28 caudal gluteal artery.² They run parallel along the length of the tail. This flap can be used for
29 wounds affecting the dorsal, gluteal and perineal areas.⁸ To reduce the risk of necrosis of the
30 distal portion of the flap, the length of the flap should not exceed 78% of the length of the tail.⁹ In
31 this case, only 40-50% of the length of the tail was used similar to the average tail length
32 reported by Montinaro et al.⁸ of 51%.
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42 There is a high complication rate reported for axial pattern flaps.^{5,7,10} The most common
43 complication reported in a recent retrospective study was incisional dehiscence.⁷ Other reported
44 complications include infection, seroma formation and oedema.^{1,5,10} Passive wound drains were
45 used in this case to minimise the risk of seroma formation and were effective in that regard.
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50 However, active closed suction drains are preferred wherever possible to avoid the risk of
51 ascending infection.^{6,7}
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56 The versatility of axial pattern skin flaps including both caudal superficial epigastric and lateral
57 caudal axial pattern flaps to manage caudal and perineal wounds has been documented in both
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dogs and cats.¹¹⁻¹⁴ However, this is the first report of the simultaneous use of both axial pattern flaps to close a large caudodorsal and perineal wound successfully.

LEARNING POINTS/TAKE HOME MESSAGES 3 to 5 bullet points – this is a required field

- Axial pattern flaps are an extremely versatile and robust method of wound reconstruction.
- The simultaneous use of caudal superficial epigastric and lateral caudal axial pattern flaps should be considered an option for closing large wounds to the caudo-dorsal and perineal area.
- Axial pattern flaps have high survival rates and the majority of complications encountered are relatively minor.

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FIGURE/VIDEO CAPTIONS *figures should NOT be embedded in this document*

Figure 1 – There was extensive ischaemic necrosis of the skin affecting the patient's right proximal thigh, caudal dorsum and perineum.

Figure 2 – The ischaemic necrosis of the skin also extended to the patients left proximal thigh.

Figure 3 – Staged debridement revealed the full extent of the patient's wound. The wound extended around to the perineum on the right hand side.

Figure 4 – Healthy granulation bed formed after extensive wound management over a fifteen day period.

Figure 5 – Closure of the right caudal superficial epigastric APF donor site with the APF rotated by 180 degrees, in preparation for its attachment to the recipient site.

Figure 6 – The patient was repositioned in left lateral recumbency and the caudal superficial epigastric flap secured to the recipient site.

Figure 7 – A high caudectomy was performed to create a lateral caudal APF.

Figure 8 – The lateral caudal APF reflected and secured dorsally at the caudo-dorsal and left lateral thigh recipient sites.

Figure 9 – The patient three weeks post operatively showing 100% survival of the APFs and hair regrowth.

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Conflict of Interest: None

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Figure 1 – There was extensive ischaemic necrosis of the skin affecting the patient’s right proximal thigh, caudal dorsum and perineum.

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Figure 2 - The ischaemic necrosis of the skin also extended to the patients left proximal thigh.

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Figure 3 – Staged debridement revealed the full extent of the patient’s wound. The wound extended around to the perineum on the right hand side.

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Figure 4 – Healthy granulation bed formed after extensive wound management over a fifteen day period.

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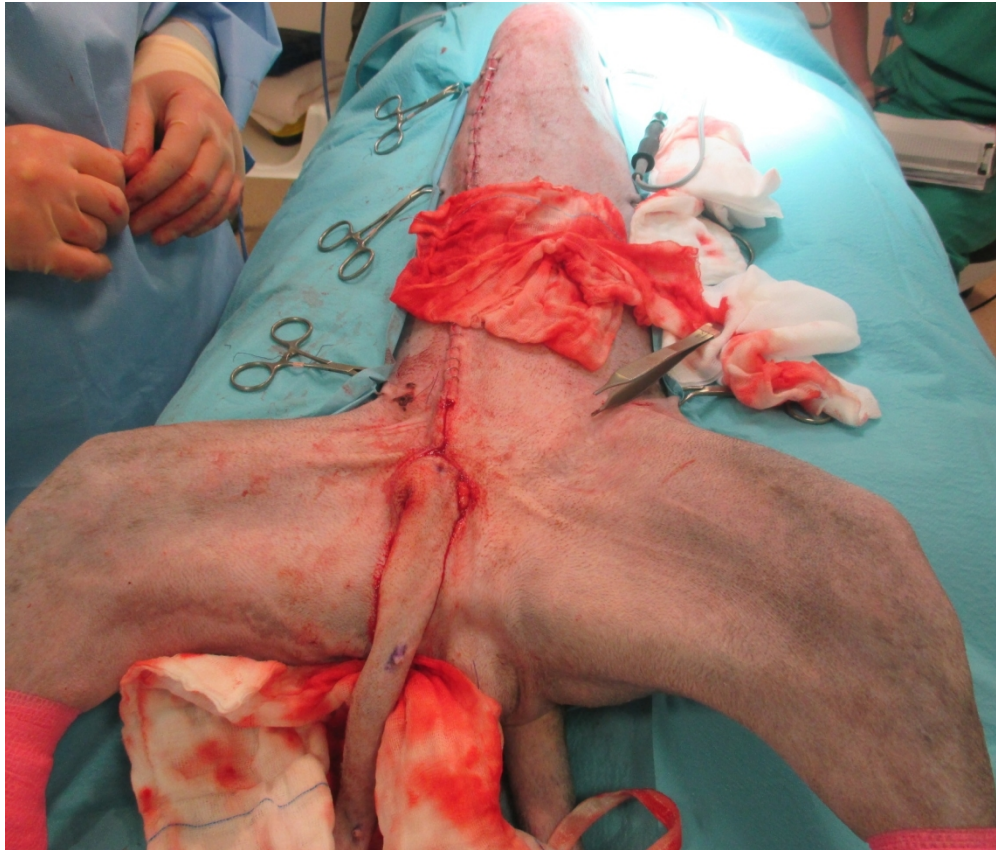


Figure 5 – Closure of the right caudal superficial epigastric APF donor site with the APF rotated by 180 degrees, in preparation for its attachment to the recipient site.

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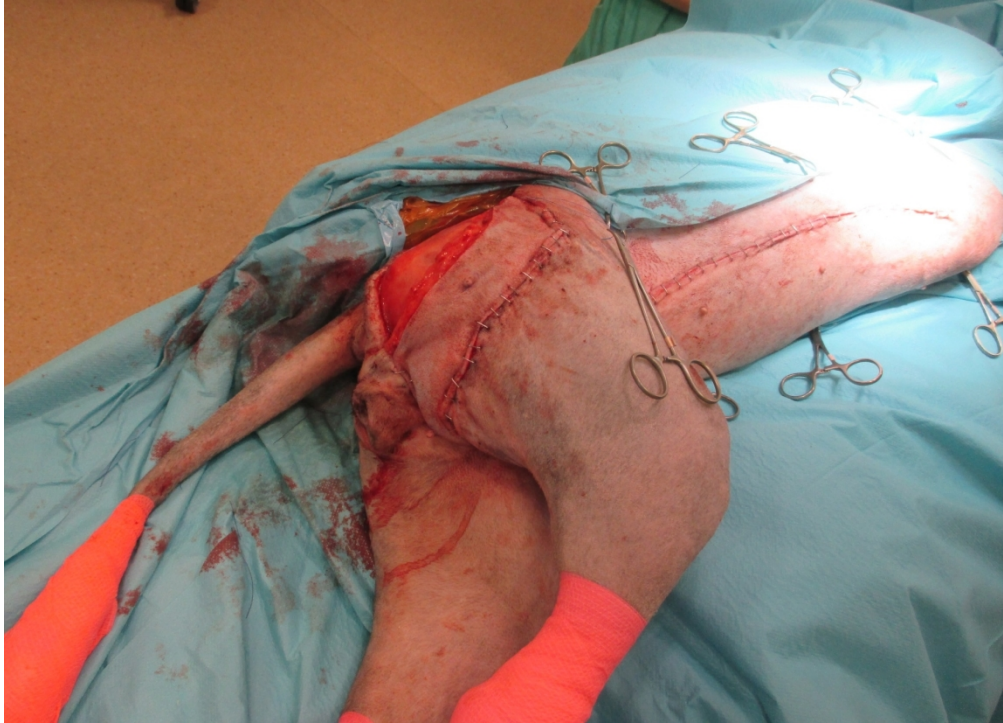


Figure 6 - The patient was repositioned in left lateral recumbency and the caudal superficial epigastric flap secured to the recipient site.

163x117mm (300 x 300 DPI)

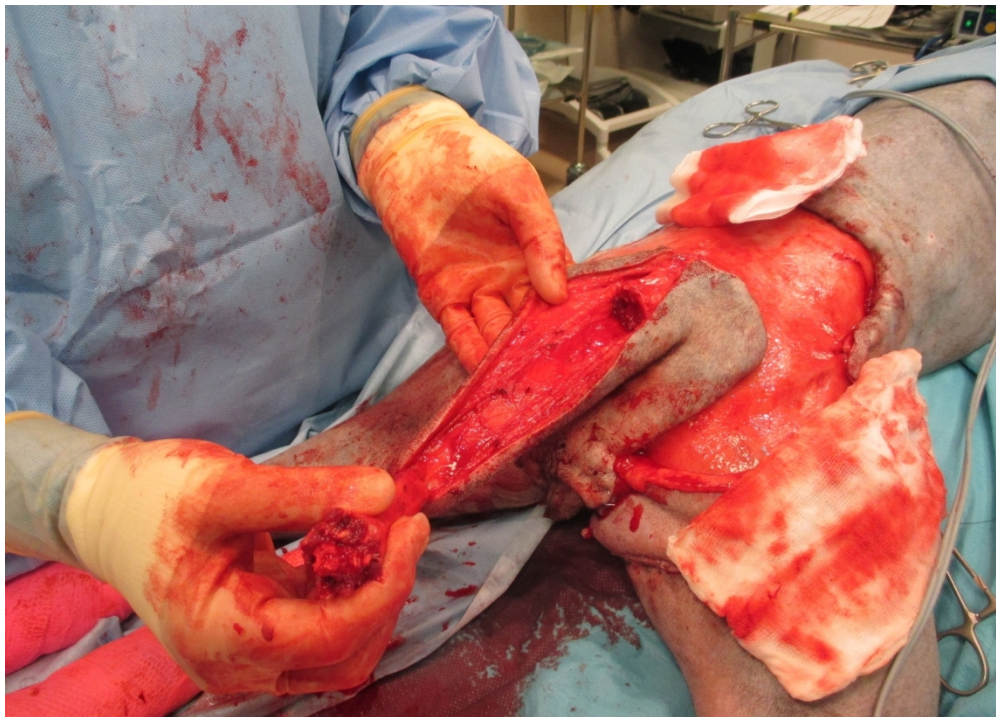


Figure 7 - A high caudectomy was performed to create a lateral caudal APF.

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Figure 8 – The lateral caudal APF reflected and secured dorsally at the caudo-dorsal and left lateral thigh recipient sites.

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Figure 9 - The patient three weeks post operatively showing 100% survival of the APFs and hair regrowth.

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<p>TITLE OF CASE <i>Do not include "a case report"</i></p> <p>Simultaneous use of a lateral caudal and caudal superficial epigastric axial pattern flap for wound closure in a dog.</p>
<p>SUMMARY <i>Up to 150 words summarising the case presentation and outcome (this will be freely available online)</i></p> <p>A dog presented following a suspected dog bite with a large area of necrotic skin centred over the caudo-dorsal lumbar area extending laterally to the left and right thigh and to the level of the vulva on the right side. This case report describes the successful use of a lateral caudal axial pattern flap used simultaneously with a caudal superficial epigastric axial pattern flap to provide complete closure of the wound. Skin flap survival was 100% with no reported complications.</p>
<p>BACKGROUND <i>Why you think this case is important – why did you write it up?</i></p> <p>Treating large skin defects in the caudo-dorsal lumbar and perineal regions can be challenging, both in respect of their immediate management and achieving wound closure. This is the first reported case where a caudal superficial epigastric axial pattern skin flap (APF) has been used in conjunction with a lateral caudal APF in a dog to successfully repair a large caudo-dorsal and</p>

1 perineal skin defect. The simultaneous use of two APFs, described in this case, provides a
2 further treatment option for managing large wounds in challenging locations.
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6 **CASE PRESENTATION** *Presenting features, clinical and environmental history*

7 A three-year-old, female neutered, German Shepherd dog was referred with a three-day history
8 of lethargy and reluctance to move. There were no previous health concerns reported. Prior to
9 referral the dog had been treated empirically with antibiotics and non-steroidal anti-inflammatory
10 drugs, but her clinical condition had not improved.
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15 On presentation the dog was reluctant to stand and move. She was tachycardic and pyrexia
16 (41.2°C) with pain elicited on palpation of the lumbosacral spine and pelvis. Matting of the
17 haircoat was noticed at this area.
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23 Under general anaesthesia the dog's hair coat was clipped revealing several large areas of
24 ischaemia and necrosis (Figure 1 and Figure 2) extending from the caudo-dorsal lumbar area
25 laterally to the left and right thigh and to the level of the vulva on the right side. A dog bite was
26 suspected and the owner confirmed that the dog had recently been attacked by another dog in
27 the house, although no wounds or blood had been noted at the time of the incident. Staged
28 sharp, surgical, hydrosurgical (Versajet®, Smith and Nephew) and mechanical (Debrisoft Pad®,
29 Lohmann and Rauscher, and wet to dry dressings) debridement of the wound was performed
30 over the following two days until the necrotic tissue had been removed revealing the full extent of
31 the wound (Figure 3). Thereafter, the wound was managed using polyurethane foam dressings
32 until a healthy granulation bed had formed (Figure 4). A swab was taken from the wound and
33 sent for culture and sensitivity **thirteen days after initial presentation**. Reconstructive surgery was
34 performed fifteen days after initial presentation.
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50 **INVESTIGATIONS** *If relevant*

51 On initial presentation there was a marked monocytosis ($5.78 \times 10^9/L$; reference range: $0.16-$
52 $1.12 \times 10^9/L$). Thoracic radiographs were unremarkable, while abdominal radiographs showed soft
53 tissue swelling over the affected region and ventral lumbar spondylosis. Bacterial culture was
54 negative.
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DIFFERENTIAL DIAGNOSIS <i>If relevant</i>

TREATMENT *If relevant*

1 The dog was anaesthetised and aseptically prepared for reconstructive surgery of the wound.

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3 The hair coat was clipped from the caudal thorax and abdomen circumferentially including both
4 hindlimbs and the tail. An indwelling urinary catheter was placed aseptically and connected to a
5 closed collection system. A purse string suture was placed in the anus and removed at the end
6 of surgery. The dog was initially positioned in dorsal recumbency, but was subsequently
7 repositioned intraoperatively into left lateral and then ventral recumbency.
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11 With the dog in dorsal recumbency, a **peninsular** right caudal superficial epigastric APF was
12 raised caudal to the second nipple using the technique described by **Pavletic**.¹ The donor site
13 was closed routinely in two layers (Figure 5). A bridging incision was made and the flap rotated
14 **without tension** by 180 degrees into the wound on the right perineum and thigh. The dog was
15 repositioned into left lateral recumbency and the flap was secured to the bridging incision, vulvar
16 skin and the ventral aspect of the right thigh wound in two layers (Figure 6) after excising the
17 margins of the wound bed. All wounds were closed in two layers using an absorbable suture
18 material using polyglecaprone (3-0 Monocryl; Ethicon) in a simple continuous pattern in the
19 subcutaneous layer and using a combination of both cruciate mattress sutures using
20 monofilament nylon (3-0 Ethilon; Ethicon) and skin staples in the skin.
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37 The dog was repositioned into ventral recumbency and a lateral caudal APF was created.¹ A
38 skin incision was made in dorsal midline along the tail incorporating approximately 40-50% of the
39 length of the tail. The caudal vertebrae were fileted out carefully to avoid damaging the lateral
40 caudal vessels and a high caudectomy performed by disarticulation (Figure 7). The remaining
41 skin around the tail base and the margins of the wound over the left dorsal thigh were
42 undermined, once again after excising the margins of the wound bed. Two ½" Penrose drains
43 were placed prior to wound closure. The lateral caudal axial pattern flap was secured dorsally at
44 the recipient site, with the skin being closed in two layers as before (Figure 8).
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1 Non-adherent dressings (Primapore; Smith and Nephew) were applied to the caudo-dorsal
2 wounds, caudal superficial epigastric donor site and around the Penrose drains. An Elizabethan
3 collar was placed to minimise self-trauma.
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7 Medetomidine (Domitor, 1mg/ml; Vétoquinol) and ketamine (Anesketin, 100mg/ml; Dechra)
8 constant rate infusions (1-2µg/kg/hr and 2-3µg/kg/hr respectively), buprenorphine (0.02mg/kg, iv,
9 qid, Alvegesic, 10mg/ml; Dechra), paracetamol (10mg/kg, po, bid) and gabapentin (15mg/kg, po,
10 bid, Gabapentin; Sandoz) provided analgesia with sedation for six days post operatively. **The**
11 **wound dressings and those covering the Penrose drains were changed as dictated by the level**
12 **of adherence, soiling and exudate.** Amoxicillin/clavulanic acid (20mg/kg, po, qid, Noroclav;
13 Norbrook) was continued peri-operatively. The urinary catheter was removed four days post
14 operatively. A urine sample, collected by cystocentesis, was sent for culture and sensitivity; a
15 negative culture was obtained. The Penrose drains were removed sequentially: the right after
16 five days and the left after six **days once the level of exudate on the dressings covering the**
17 **drains had subjectively reduced to that expected due to the presence of the drains alone.**
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19 The dog was discharged eight days post operatively. The paracetamol, gabapentin and
20 amoxicillin/clavulanic acid were continued orally for seven days.
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36 **OUTCOME AND FOLLOW-UP**

37 Skin sutures and staples were removed fifteen days post operatively. At this time there was no
38 evidence of wound dehiscence or necrosis of the skin flaps. Three weeks post operatively the
39 axial pattern flap survival was 100% (Figure 9). The patient was subsequently lost to follow-up.
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41 Management of large wounds in the caudo-dorsal and perineal region can be challenging
42 because the skin is relatively less mobile than in other regions of the body making simple
43 appositional wound closure difficult.^{2, 3} The close proximity to the anus and vulva, with the
44 associated risk of urine and faecal soiling of the wounds and dressings, can also be problematic.
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55 **DISCUSSION** *Include a very brief review of similar published cases*

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57 Axial pattern skin flaps incorporate direct cutaneous arteries and veins and are consequently
58 useful in the management of large wounds because they allow for mobilisation of large areas of
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1 full thickness skin.^{3, 4} The presence of an independent blood supply also means they are useful
2 in wound beds which may be infected or otherwise compromised.³
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4 Many APFs have been described, but the caudal superficial epigastric axial pattern flap is one of
5 the most adaptable and commonly used.^{3, 5} It can be used for closure of wounds to the caudal
6 abdomen, flank, perineum, prepuce and hindlimbs.^{4, 6, 7} The superficial epigastric vein and artery,
7 a branch of the external pudendal artery, pass through the inguinal canal, providing blood supply
8 to this flap.⁶ The flap commonly incorporates three to four caudal mammary glands that will
9 remain functional and so ovariohysterectomy is recommended.⁶ The caudal superficial epigastric
10 flap has a wide arc of rotation and is most commonly used as a peninsular flap retaining a
11 cutaneous connection at the base of the flap.³ It can also be used as an island flap whereby the
12 cutaneous connection is cut and the flap's only attachment to the donor site is the vascular
13 bundle increasing the flap's arc of rotation. **This was not required in this case because the length
14 of the flap created avoided tension on the flap as it was rotated, and the vessels were well
15 protected by fat.**
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31 The lateral caudal axial pattern flap incorporates the lateral caudal arteries, which arise from the
32 caudal gluteal artery.² They run parallel along the length of the tail. This flap can be used for
33 wounds affecting the dorsal, gluteal and perineal areas.⁸ To reduce the risk of necrosis of the
34 distal portion of the flap, the length of the flap should not exceed 78% of the length of the tail.⁹ In
35 this case, only 40-50% of the length of the tail was used similar to the average tail length
36 reported by Montinaro et al.⁸ of 51%.
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46 There is a high complication rate reported for axial pattern flaps.^{5, 7, 10} The most common
47 complication reported in a recent retrospective study was incisional dehiscence.⁷ Other reported
48 complications include infection, seroma formation and oedema.^{1, 5, 10} Passive wound drains were
49 used in this case to minimise the risk of seroma formation and were effective in that regard.
50 However, active closed suction drains are preferred wherever possible to avoid the risk of
51 ascending infection.^{6, 7}
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1 The versatility of axial pattern skin flaps including both caudal superficial epigastric and lateral
2 caudal axial pattern flaps to manage caudal and perineal wounds has been documented in both
3 dogs and cats.¹¹⁻¹⁴ However, this is the first report of the simultaneous use of both axial pattern
4 flaps to close a large caudodorsal and perineal wound successfully.
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10 **LEARNING POINTS/TAKE HOME MESSAGES 3 to 5 bullet points – this is a required field**

- 13 • Axial pattern flaps are an extremely versatile and robust method of wound reconstruction.
- 14 • The simultaneous use of caudal superficial epigastric and lateral caudal axial pattern
15 flaps should be considered an option for closing large wounds to the caudo-dorsal and
16 perineal area.
- 17 • Axial pattern flaps have high survival rates and the majority of complications encountered
18 are relatively minor.

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FIGURE/VIDEO CAPTIONS *figures should NOT be embedded in this document*

Figure 1 – There was extensive ischaemic necrosis of the skin affecting the patient’s right proximal thigh, caudal dorsum and perineum.

Figure 2 – The ischaemic necrosis of the skin also extended to the patients left proximal thigh.

Figure 3 – Staged debridement revealed the full extent of the patient’s wound. The wound extended around to the perineum on the right hand side.

Figure 4 – Healthy granulation bed formed after extensive wound management over a fifteen day period.

Figure 5 – Closure of the right caudal superficial epigastric APF donor site with the APF rotated by 180 degrees, in preparation for its attachment to the recipient site.

Figure 6 – The patient was repositioned in left lateral recumbency and the caudal superficial epigastric flap secured to the recipient site.

Figure 7 – A high caudectomy was performed to create a lateral caudal APF.

Figure 8 – The lateral caudal APF reflected and secured dorsally at the caudo-dorsal and left lateral thigh recipient sites.

Figure 9 – The patient three weeks post operatively showing 100% survival of the APFs and hair regrowth.

OWNER’S PERSPECTIVE *Optional*

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Conflict of Interest: None

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